I Claim:

1. A method for acoustically sounding air over a range that extends away from an acoustic transmitter and receiver the method comprising the steps of:

transmitting an acoustic chirp comprising coded pulses having pulse compression waveforms and having a duration of at least 300 ms down-range,

using the receiver to detect acoustic inputs and to generate a receiver output that is representative of said inputs, and

processing said receiver output to generate signal phase data indicative of air characteristics in the range.

2. A method according to claim 1, wherein said step of using the receiver to detect acoustic inputs includes detecting echoes returned by the chirp while the chirp is still being transmitted.

3. A method according to claim 1 including the steps of:

using the receiver means to detect first acoustic inputs, including echoes returned in a first direction from the chirp, to generate a first receiver output related to said first inputs,

using the receiver means to detect second acoustic inputs, including echoes returned in a second direction from the chirp, to generate a second receiver output related to said second inputs,

generating, using at least one of Fourier and matched filter techniques, a first phase signal comprising phase-related components from said first receiver output,

generating, using at least one of Fourier and matched filter techniques, a second phase signal comprising phase-related components from said second receiver output,

manipulation of said first and second phase signals to generate data relating air characteristics in range.

4. A method according to claim 3 wherein said manipulation includes the step of:

adding said first and second phase signals to generate a first additive phase signal that emphasizes common components of said first and second phase signals indicative of down range air movement and to reduce components of said phase signals indicative of cross-range air movement.

5. A method according to claim 4 wherein said manipulation includes the step of:

subtracting from said first additive phase signal a reference phase signal indicative of system phase noise.

6. A method according to claim 3 wherein:

said first acoustic inputs include a first direct-chirp signal received direct from the transmitter having substantially no echo component,

said second acoustic inputs include a second direct-chirp signal received direct from the transmitter having substantially no echo component, and

said manipulation includes subtracting said first and second phase signals to generate a phase output signal that is substantially free of said first and second direct-chirp signals.

7. A method according to claim 3 wherein said manipulation includes:

removing phase signal components that are common to said first and second phase signals and that are at least in part due to system noise and to acoustic noise that is common to said first and second acoustic signals.

8. A method according to claim 3 wherein:

said first and second directions are inclined substantially equally and oppositely to one another and fall substantially in a first plane that extends cross-range, and

said manipulation of the first and second phase signals generates data indicative of cross-range air movement within or parallel to said first plane.

9. A method according to claim 3 including the steps of:

using the receiver to detect third acoustic inputs, including echoes returned in a third direction from the transmitted chirp, to generate a third receiver output related to said third inputs,

using the receiver to detect fourth acoustic inputs, including echoes returned in a fourth direction from the chirp, to generate a fourth receiver output related to said fourth inputs,

generating, using at least one of Fourier and matched filter techniques, a third phase signal comprising phase-related components from said third receiver output,

generating, using Fourier techniques, a fourth phase signal comprising phase-related components from said fourth receiver output, and

manipulation of said third and fourth phase signals to generate data relating air characteristics in range.

10. A method according to claim 9 wherein:

said third and fourth directions are inclined substantially equally and oppositely to one another and fall substantially in a second plane that extends cross-range, and

said manipulation of the third and fourth phase signals generates data indicative of cross-range air movement in said second plane, and

said manipulation of the third and fourth phase signals generates data indicative of cross-range air movement within or parallel to said second plane.

11. A method according to claim 10, wherein said first plane and said second planes are substantially orthogonal to one another, and said manipulation including the steps of:

differencing said first and second phase signals to remove phase signals common thereto and to generate first differential phase components indicative of air movement in or parallel to said first plane,

differencing said third and fourth phase signals to remove phase signals common thereto and to generate second differential phase components indicative of air movement in or parallel to said second plane.

12. A method according to claim 11 wherein said manipulation includes the step of combining the first and second differential phase signals to generate phase signals indicative of at least one of the bearing of cross-range wind relative to the down-range direction and phase signals indicative of cross-range wind shear.

13. A method according to claim 11 wherein:

the range extends substantially vertically from the transmitter and receiver means, which are located near at or near the base of the range,

the first and second planes are substantially vertical,

the first plane extends cross-range in a north-south alignment,

the second plane extends cross-range in an east-west alignment, and

said manipulation of said first, second third and fourth phase signals generates data indicative of the variation of the compass bearing and velocity of cross-range air movement.

14. A method according to claim 9 wherein said manipulation includes the step of:

adding said first, second, third and fourth phase signals to generate a second first additive phase signal that emphasizes common components of said first, second. third and fourth phase signals indicative of down range air movement and to reduce components of said phase signals indicative of cross-range air movements.

15. A method according to claim 14 wherein said manipulation includes the step of:

subtracting from said second additive phase signal a reference phase signal indicative of system phase noise.

16. A method according to claim 1 wherein the chirp is a positive or negative linear acoustic signal that has an increasing or decreasing phase or frequency, or wherein both positive and negative linear chirps are employed.

17. A method according to claim 16 including the steps of:

transmitting positive and negative chirps in sequence,

deriving respective positive and negative versions of said receiver outputs,

processing said positive and negative receiver outputs to generate corresponding positive and negative signal phase data,

differencing said positive and negative signal phase data to generate third differential data indicative of variation of air temperature with range distance.

18. A method according to claim 16 including the steps of:

simultaneously transmitting positive and negative chirps that do not employ the same acoustic tones,

deriving respective positive and negative versions of said receiver outputs,

processing said positive and negative receiver outputs to generate corresponding positive and negative signal phase data,

differencing said positive and negative signal phase data to generate fourth differential data indicative of variation of air temperature with range distance.

19. A method according to claim 17 including the step of:

differentiating said respective third or fourth differential phase signal to derive a gradient signal that is indicative of the variation of air temperature with range distance.

20. A method according to claim 1

wherein said processing step includes generating ambient signal phase data in the absence of an air disturbance at a location, and including the steps of:

generating disturbance signal phase data in the presence of the local air disturbance at said location, and

using said ambient signal phase data to normalize the disturbance signal phase data and to thereby generate normalized signal phase data.

21. A method according to claim 20 including the steps of:

correlating successive samples of said normalized phase data against multiple Doppler values to generate data indicative of wind speed with respect to distance.

22. A method according to claim 1 wherein signal amplitude data is generated and used together with said signal phase data.

23. A method according to claim 1 wherein the duration of the chirp is greater than five seconds.

24. A system for acoustically sounding air over a range that extends away from an acoustic transmitter and receiver comprising:

a transmitter adapted to transmit an acoustic chirp comprising coded pulses having pulse compression waveforms and having a duration of at least 300 ms down a range that extends away from the transmitter,

a receiver located near said transmitter and adapted to detect acoustic signals including echoes of the transmitted chirp returned from down-range and adapted to generate a receiver output that is representative of said received acoustic signals, and

a digital signal processor for processing said receiver output to generate signal phase data indicative of air characteristics in the range.

25. A system according to claim 24 wherein:

said receiver is adapted to detect a direct non-echo signal from the transmitter while it is transmitting, said direct signal contributing to said receiver output.

26. A system according to claim 24 wherein:

said receiver is adapted to detect first acoustic inputs, including echoes returned in a first direction from the chirp, and to generate a first receiver output related to said first inputs,

said receiver is adapted to detect second acoustic inputs, including echoes returned in a second direction from the chirp, and to generate a second receiver output related to said second inputs,

said signal processor is adapted to

receive said first and second receiver outputs,

process said outputs using at least one of a matched filter and a Fourier processor,

generate respective first and second phase signals, and

manipulate said first and second phase signals to generate data relating air characteristics in the range.

27. A system according to claim 26 wherein the signal processor, when manipulating said first and second phase signals, is adapted to:

add said first and second phase signals to generate a first additive phase signal that emphasizes common components of said first and second phase signals indicative of down range air movement and to reduce components of said phase signals indicative of cross-range air movement.

28. A system according to claim 27 wherein the signal processor, when manipulating said first and second phase signals, is adapted to:

subtract from said first additive phase signal a reference phase signal indicative of system phase noise.

29. A system according to claim 26 wherein the signal processor, when manipulating said first and second phase signals, is adapted to:

subtract said first and second phase signals to generate a phase output signal that is substantially free of direct-chirp signal components.

30. A system according to claim 26 wherein the signal processor, when manipulating said first and second phase signals, is adapted to:

remove phase signal components that are common to said first and second phase signals and that are inter alia due to system noise and to acoustic noise that is common to said first and second acoustic signals.

31. A system according to claim 26 wherein:

said first and second directions are inclined substantially equally and oppositely to one another and fall substantially in a first plane that extends cross-range, and

the signal processor, when manipulating said first and second phase signals, is adapted to generate data indicative of cross-range air movement within or parallel to said first plane.

32. A system according to claim 26 wherein:

said receiver is adapted to detect third acoustic inputs, including echoes returned in a third direction from the transmitted chirp, to generate a third receiver output related to said third inputs,

said receiver is adapted to detect fourth acoustic inputs, including echoes returned in a fourth direction from the chirp, to generate a fourth receiver output related to said fourth inputs,

said signal processor is adapted to use at least one of Fourier and matched filter techniques to generate a third phase signal comprising phase-related components from said third receiver output,

said signal processor is adapted to use at least one of Fourier and matched filter techniques to generate a fourth phase signal comprising phase-related components from said fourth receiver output, and

said signal processor is adapted to manipulate said third and fourth phase signals to generate data relating air characteristics in the range.

33. A system according to claim 32 wherein:

said third and fourth directions are inclined substantially equally and oppositely to one another and fall substantially in a second plane that extends cross-range, and

said manipulation of the third and fourth phase signals is adapted to generate data indicative of cross-range air movement in said second plane, and

said signal processor is adapted to manipulate the third and fourth phase signals to generate data indicative of cross-range air movement within or parallel to said second plane.

34. A system according to claim 33, wherein said first plane and said second planes are substantially orthogonal to one another, and wherein:

said signal processor is adapted to:

difference said first and second phase signals to remove phase signals common thereto and to generate first differential phase components indicative of air movement in or parallel to said first plane, and

difference said third and fourth phase signals to remove phase signals common thereto and to generate second differential phase components indicative of air movement in or parallel to said second plane.

35. A system according to claim 34 wherein said signal processor is adapted to combine the first and second differential phase signals to generate phase signals indicative of the bearing of cross-range wind relative to at least one of the downrange direction and phase signals indicative of cross-range wind shear.

36. A system according to claim 34 wherein:

the range extends substantially vertically from the transmitter and receiver, which are adapted to be located at or near the base of the range,

the first and second planes are substantially vertical,

the first plane extends cross-range in a north-south alignment,

the second plane extends cross-range in an east-west alignment, and said signal processor is adapted to manipulate said first, second third and fourth phase signals to generate data indicative of the variation of the compass bearing and velocity of cross-range air movement.

37. A system according to claim 33 wherein said signal processor is adapted to add said first, second, third and fourth phase signals to generate a second first additive phase signal that emphasizes common components of said first, second, third and fourth phase signals indicative of down range air movement and to reduce components of said phase signals indicative of cross-range air movements.

38. A system according to claim 36 wherein said signal processor is adapted to subtract from said second additive phase signal a reference phase signal indicative of system phase noise.

39. A system according to claim 24 wherein the transmitter is adapted to transmit a chirp comprising a positive or negative linear acoustic signal that has an increasing or decreasing phase or frequency, or wherein both positive and negative linear chirp's are employed.

40. A system according to claim 39 wherein:

the transmitter is adapted to transmit positive and negative chirps in sequence,

the receiver is adapted to generate respective positive and negative versions of said receiver outputs from acoustic input signals including said positive and negative chirps and echoes thereof,

said signal processor is adapted to:

process said positive and negative receiver outputs to generate corresponding positive and negative signal phase data, and

difference said positive and negative signal phase data to generate third differential data indicative of variation of air temperature with range distance.

41. A system according to claim 39 wherein:

said transmitter is adapted to simultaneously transmit positive and negative chirps that do not employ the same acoustic tones,

said receiver is adapted to generate respective positive and negative receiver outputs,

said signal processor is adapted to:

process said positive and negative receiver outputs to generate corresponding positive and negative signal phase data, and

difference said positive and negative signal phase data to generate fourth differential data indicative of variation of air temperature with range distance.

42. A system according to claim 40 wherein:

said signal processor is adapted to differentiate said (respective) third or fourth differential phase signal to derive a gradient signal that is indicative of the variation of air temperature with range distance.

43. A system according to claim 24 adapted to:

generate ambient signal phase data in the manner claimed in the absence of an air disturbance at a location,

generate disturbance signal phase data in the presence of the local air disturbance at said location, and

use said ambient signal phase data to normalize the disturbance signal phase data and to thereby generate normalized signal phase data.

44. A system according to claim 43 wherein said signal processor is adapted to correlate successive samples of said normalized phase data against multiple Doppler values to generate data indicative of wind speed with respect to distance.